Is the U.S. Environmental Protection Agency Brownfields Assessment Pilot Program Environmentally Just?

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In the early 1990s, the U.S. Environmental Protection Agency (U.S. EPA) started a grant program to assist communities redevelop brownfields, which are abandoned or underutilized sites that have real or perceived contamination. In addition to determining if the communities receiving the grants were the most distressed cities in the United States, we also evaluate the U.S. EPA program in terms of environmental justice at the macro scale. Using 1990 U.S. Census of Housing and Population data and a matched-cities methodology, we compared the brownfields pilot cities to other communities in the United States. We found that regardless of intent, the U.S. EPA program is environmentally just by disproportionately awarding grants to the most economically distressed cities. We also found that the cities that received funding in the early years of the program were more economically distressed than cities receiving the funding more recently. ***Key words*****: brownfields, environmental justice, redevelopment, U.S. EPA.** ***Environ Health Perspect*** **110(suppl 2):249–257 (2002).**
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The objective of our research is to measure the extent to which recipients of brownfields assessment pilot grants from the U.S. Environmental Protection Agency (U.S. EPA) are cities that contain relatively poor, disadvantaged, minority populations and other characteristics assumed to be associated with environmental justice concerns.

This objective is linked to one of the underlying hopes about brownfields redevelopment: that it can help address environmental inequity by *a*) reducing health-threatening exposures from brownfields sites and *b*) raising the quality of life by adding jobs and other desirable community facilities in stressed neighborhoods to benefit the residents. Although they are not necessarily the cause, brownfields are associated with numerous personal, environmental, and economic problems (*1–4*). Their presence may increase the exposure of an individual or a community to health threats. For instance, an abandoned factory may become an exploratory playground for youth who unknowingly expose themselves to toxins such as lead, mercury, and solvents. Depending on the type and level of contamination, a particular brownfields site can threaten air or drinking water quality. These potential health hazards include but are not limited to life-shortening exposure, acute illness, chronic illness, chronic disability, and minor or temporary illness (*5*). A current controversial example is the building of new schools on brownfields. A debate about this reuse is now occurring, with opponents such as the Center for Health, Environment, and Justice in Falls Church, Virginia arguing that remnant contamination could expose children and raise the liability of school systems. Proponents, including many developers, assert that brownfields can be cleaned up to acceptable levels and, if left underdeveloped, present a public threat.

Although brownfields are located in a variety of neighborhoods ranging from affluent suburban communities to some of our country's poorest urban ghettos, it is brownfields of the latter type that are most often researched (*1–4*). In these places, brownfields are found typically in neighborhoods experiencing blight. They are located next to abandoned residential and commercial properties. In these neighborhoods the occupied houses and businesses, the infrastructure, and the public facilities are often in poor or dilapidated condition. The neighborhoods have experienced extreme job loss and the residents are victims to high crime rates. Of course, brownfields are also in other neighborhoods that are not under such stress. In these places, brownfields are considered burdens because they can lower property taxes, diminish the natural beauty of the area, and contaminate the water supply.

The potential benefits of brownfields redevelopment are environmental, economic, and social. Specifically, their redevelopment could improve the neighborhood quality of life by fostering both a healthier environment and economy (*3*,*6*). Cleaning them up and removing or reducing the contamination would reduce health risks, and their reuse could also help preserve suburban greenspace and control urban sprawl. The economic life restored to these sites could create jobs and bring in tax dollars. Brownfields redevelopment is also purported to help bring about environmental justice (*1*), an issue that took on national presence in February 1994, when President Clinton issued an executive order that established environmental justice as a goal for all federal agencies (*7*).

The concept of environmental justice is not clear-cut. Ask one person to define environmental justice and you will get one answer; ask another, and get a different answer. However, if you were to categorize the responses, three major factors would most likely appear: economic, environmental, and process (e.g., legal, political). Environmental justice can be viewed through an economic lens and measured by the number and type of jobs, an increase in the tax base, or an improvement in infrastructure and education (*8–10*). The environmental approach perceives environmental justice as balancing benefits and burdens, better environmental health, and overall improvement in the quality of life, and the demise of a real or perceived correlation between environmentally devastated neighborhoods and poor or minority residents (*8,11*). Looking at environmental justice through the process lens, one might measure it as the empowerment of the disenfranchised: the legitimization of community perceptions, community-based planning, and popular epidemiology, or an increase of minority participation in decision making that is supported by elected leadership, the business community, and middle-class residents (*12*). Research by Wakefield and Elliot has shown that the process may be as important, if not more so, than the outcome in terms of individual well-being (*13*). Our work and the following research focus mainly through the process lens.

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To understand the potential impact of brownfields redevelopment on environmental justice, we must first step back and look at three cornerstones of the link between brownfields and environmental justice. One cornerstone is the idea of community. Who is being affected by contamination and could benefit by remediation? How is this community defined? Kasperson and Dow (*14*), Zimmerman (*15,16*), and Greenberg and Cidon (*17*) made significant contributions to the studies of environmental equity by detailing the various criteria that can be used to define a potentially affected community: *a*) activity of the users, such as residents, workers, or recreationists; *b*) location to the externality: are they near the site, along a transportation route, or in an area affected by off-site exposure; *c*) socioeconomic status, including race, class, gender, or age; *d*) health status or other sensitivity; or *e*) some combination of the preceding elements.

The second issue to consider is the characterization of what constitutes an environmental externality or burden. Many of the early studies (*12,18*) on environmental equity had a narrow focus and usually examined only municipal or hazardous landfills as the environmental burden. As the environmental justice field developed, so did the list of possible externalities. Environmental justice studies have been conducted on issues ranging from prisons (*17*) to toxic release inventory data (*16*). Now researchers are also considering brownfields as environmental externalities that can be turned into a neighborhood benefit (*19*).

The third area to consider for understanding the impact of brownfields redevelopment on environmental justice is the notion of disproportion. Under what circumstances does a community have more than its fair share of the externality or burden? Specifically, what are the measurements for determining this disproportion? The question is, when is something unfair? There are two main issues: the burden's presence in other communities and its balance with desirable activities/land uses. To say that a community has a disproportionate amount of externality, there must be some unit for comparison. Several geographic units are available for comparison, including adjacent areas, areas with similar demographics, areas with the same or similar burdens, the next larger geographic area, states, and the nation (*16*). In addition, Greenberg and Cidon argue that another way to gauge inequity is to measure a community's balance of externalities (or burdens) to benefits. If a community has many burdens and few benefits, one could say it suffers from environmental inequity. Such benefits could include parks, schools, and restaurants (*17*).

Although there are many ways to define a community, in accordance with the structure of the U.S. EPA pilot program, in which grants are offered only to political jurisdictions, we are using the political jurisdiction for our analysis. Thus, for this environmental justice study, which centers on an analysis of cities receiving funding for brownfields redevelopment, we define the community by the socioeconomic status, racial ethnicity, housing, and other demographic characteristics of the political jurisdiction. The justice issue being scrutinized is access to funding provided to redevelop brownfields. The geographic units for comparison are other cities, states, and the nation as a whole.

Environmental justice is a multispatial scale phenomenon. The data analyzed here will determine if the U.S. EPA pilot money was, on the whole, given to the communities with the strongest cases for environmental injustice. That is, has the U.S. EPA taken the first step of putting money in the hands of the mayors of the neediest cities? Will these mayors use the money in the neediest neighborhoods where environmental justice is most problematic? That is a question not to be answered in this study but one that should be answered in future research.

More specifically, the main research question for this study is, has the U.S. EPA brownfields redevelopment program functioned implicitly as an environmental justice program? Has it targeted the most economically distressed cities in the United States? Has it given grant money for redevelopment for projects in cities with high poverty, high unemployment, and other indicators of stress? This is not a question of intent. We are not asking if the U.S. EPA purposely set out to have the brownfields redevelopment program address environmental justice on a citywide scale. Instead of evaluating the results of the grants, we are evaluating whether the U.S. EPA brownfields program, purposely or not, disproportionately addresses places that have the characteristics of poverty, blight, and other indicators of social and environmental injustice.

The U.S. EPA Brownfields Program

The U.S. EPA defines brownfields as "abandoned, idled, or underused industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination" (*20*).

Cities in the United States have been redeveloping urban sites for decades, some of which are contaminated brownfields. However, it was not until the early to mid-1990s that the federal government became involved in redevelopment of contaminated sites (also called brownfields), with the U.S. EPA taking the federal lead. The U.S. EPA has developed a brownfields program aimed at bringing together and aiding communities and various stakeholders so that they can redevelop brownfields.

Before focusing on the U.S. EPA brownfields pilot program, we want to note that the movement for environmental justice and redevelopment of urban properties has also been charged by the perceived negative effects of other U.S. EPA programs on urban redevelopment, notably Superfund. The federal government and many state governments mandate the cleanup of contaminated property with a primary focus on liability. The 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (*21*) is the foremost federal law, frequently referred to as Superfund for one of the funds it established. Numerous studies claim that the CERCLA, particularly its liability regulations, had all but stopped the redevelopment of brownfields sites, including those that had little, if any, contamination. According to the studies, without federal government involvement with the brownfields programs that reduced liability, these sites were not going to be redeveloped; thus the initiatives of the U.S. EPA and other agencies were created (*22–25*).

The U.S. EPA brownfields initiative was the second attempt at major reform of CERCLA. The first attempt was the Superfund Amendments and Reauthorization Act (SARA) of 1986 (*26*). The brownfields initiative addressed CERCLA's impediments to redevelopment in several ways, the most significant being the removal of sites from the Superfund list. In April 1997, as part of its brownfields initiatives, the U.S. EPA removed approximately 30,000 sites from its Superfund list, or more specifically from the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) (*27*). By removing these sites from CERCLIS, the U.S. EPA removed a major obstacle to their redevelopment. Lenders and insurers typically consider CERCLIS sites to be high risk, making it difficult for developers to secure funding for site development.

Before the existence of the brownfields program, myriad urban sites were not considered for development because they were on a federal database from which sites could be moved to the National Priority List, or Superfund. Those who owned properties on that list or those considering purchase of such properties were potentially subject to severe economic penalties and drawn-out and expensive lawsuits. In various mass-media articles, officials and journalists characterized Superfund as a horror story, a nightmare, and

a broken program, and the brownfields initiatives as a model of what is going to be necessary to move urban economic redevelopment forward in the next century (*2*). In the context of 1993–1995, this was a common theme, that is, Superfund retarded economic redevelopment of the places that most needed it, and the brownfields program was a so-called win–win program for everyone (*19*).

The Brownfields Assessment Demonstration Pilot program is the best-known brownfields program and it is the focus of this paper. The program was implemented in three cities: Bridgeport, Connecticut; Richmond, Virginia; and Cleveland, Ohio, in the early 1990s, and has now expanded to provide grants to over 300 U.S. states, cities, towns, counties, and Native American tribes. The pilots (the places receiving grants) receive funding of up to $200,000 over a 2-year period. This money can be used for a number of activities related to brownfields redevelopment, including brownfields site assessment, identification, characterization, and cleanup plans. The funds cannot be used for the actual cleanup of sites. Brownfields sites are being redeveloped for a full spectrum of reuses, including affordable and market-rate housing, parks, hotels, malls, and manufacturing sites (*28*). On the basis of a nationwide telephone survey conducted with U.S. EPA brownfields pilot managers, Solitare was able to determine that, across the country, there was a wide range of reuses for brownfields sites. Although the mostly frequently cited planned reuse was industrial, Solitare also found numerous other examples, including an ecology center (New Orleans, Louisiana); a greenway (Richmond, California); single-family housing (Pittsburgh, Pennsylvania); mixed use with commercial and affordable housing (San Francisco, California); and a train museum and park (Prichard, Alabama) (*28*).

These U.S. EPA brownfields pilot grants are awarded to communities that meet the program's goals of trying to link brownfields redevelopment to community revitalization and pollution prevention programs. The cities participating are both self-selected and chosen. They must first apply to the U.S. EPA; the U.S. EPA then applies competitive criteria to select cities for grants. Some of the specific criteria used by the U.S. EPA in offering the grant include the effect of brownfields on the community, the level of community involvement in the redevelopment, the environmental justice effects of the redevelopment, and the long-term benefits and sustainability of the redevelopment. In terms of environmental justice, the U.S. EPA is concerned with how low-income, minority, and other disadvantaged persons will participate in the brownfields redevelopment (*20*). Once a pilot grant is issued, it is up to the recipient to carry out the goals of the application. The U.S. EPA, both national and regional, has minimal oversight beyond reporting requirements.

Nature of the Study

We wanted to know what kinds of cities the U.S. EPA brownfields program is serving. Are they cities subject to strain or difficulties associated with major economic and social problems such as a declining economic base, high unemployment and poverty rates, poor education systems, dilapidated infrastructure, high crime, and poor public health? Are they cities with more low-income, minority, and other disadvantaged persons than other places? Specifically, we wanted to know the characteristics of U.S. EPA brownfields pilot cities and how these cities differ from other cities, their home states, and the nation.

This research adopts the definition of outcome environmental equity (*1*) with regard to environmental justice. This definition looks at the present situation and evaluates it regardless of the processes that caused it to occur. In the case of the U.S. EPA brownfields program, this means that if the U.S. EPA did not provide grants to the most needy places, there is an injustice. However, we are not interested in placing blame. Any injustice might be due to the way in which the U.S. EPA evaluated the applications, or it might be due to factors involving the cities themselves. Cities might not be selected for a pilot grant because they did not file an application or because their application was weak. In this research the findings are not linked to a specific cause or causes. Thus, if the pilot program is environmentally just, the U.S. EPA pilot cities should be the most distressed cities.

Study Methods

We have undertaken both a descriptive and a comparative statistical analysis of these U.S. EPA brownfields pilot cities. For the purposes of this research, U.S. EPA brownfields pilot cities are defined as those cities that received grant money from the U.S. EPA under the brownfields demonstration pilot program prior to 1 May 1999. This data set does not include other jurisdictions such as U.S. states and Indian nations that received grants. One reason for not including them is the difficult problem of finding matches. Almost every state has at least one brownfields program, and we do not have suitable matches for the tribal nations. A second reason we have chosen to focus only on cities is that they make up the largest portion of pilot recipients. As of December 2001, almost three of four grants (73%) were issued to cities, whereas county governments received 11% of the grants, regional governments received 8%, Indian tribes and nations received 5%, and states received 4%. [Source: Solitare's calculations based on analysis of all U.S. EPA pilots awarded through December 2001 (*28*).] There are 184 cities that fit the U.S. EPA definition of brownfields pilot cities (Table 1). These cities are distributed across the United States. Approximately 35% of the pilot cities are in the Northeast, 22% in the South, 24% in the Midwest, and 20% in the West. They are in 43 different states, plus the District of Columbia.

Variables

We used two data sources. The majority of the data are from the 1990 U.S. Census of Population and Housing (*29*); the remainder are from the 1994 County and City Data Book (*30*). Although both of these data sources are more than 10 years old, they are the most appropriate sources. Using this older data, we are able to capture the characteristics of the cites before or at the time they received the pilot funding, as opposed to using more recent data, which would have told us only what the pilot cities look like since receiving the funding. The data collected describe the characteristics of either the residents or their housing units. The data provide a picture of how pilot cities differ from other places in terms of race and ethnicity, family structure, socioeconomic status, health, and housing (Table 2). To control for differences in city size, we converted most of the data into rates or percentages. We could not locate the required data for two pilot cities: Colrain and Methuen, Massachusetts. In addition, for some cities with 1990 population under 25,000, data were not available for a few variables, including elderly poverty, infant death rate, and serious crime rate. We do not believe this missing data results in any significant bias in our results, because so few data were missing. Furthermore, these were among the least-populated places.

We used several census variables as indicators to measure the economic and social health of cities. We included indicators of race and ethnicity, family structure, social mobility, income and poverty, housing, and public safety. A brief description of the variables follows. To describe race and ethnicity we used the percentage of the population that was non-White, of Hispanic origin, or foreign born, and the percentage of households that were linguistically isolated. If the U.S. EPA program is environmentally just, a disproportionate number of grants should be offered to places with these minority populations.

To describe family structure, we selected variables on age, head of household, and mobility. We used three age variables: percentages of persons under 5 years of age, persons 5–17 years of age, and persons over

the age of 65 years. On the basis of established poverty studies, we chose to use female head of households with children as a proxy indicator for welfare dependence (*31,32*). The only head-of-household variable we used was female head of households with children. For mobility, which serves as a proxy indicator of short-term tenure and thus the possible need for community outreach and services (*31,32*), we used three variables describing location of residence in 1985: percentage of persons living in the same house, persons living in a different house but in the same center city, and persons living in a different house, not in the center city, but in the same metropolitan statistical area (MSA).

For the program to be environmentally just, grants should disproportionately be made to places where family structure is headed by females, where the population has migrated frequently, and generally, where the family structure implies a need for more jobs and services.

We used three categories of variables to describe the socioeconomic status of the residents: income, employment, and health and safety. In the income category we used five variables: median household income and poverty rates for persons, families, female head of households, and persons over the 65 years of age. To describe the employment we used the following variables: unemployment

Table 1. All U.S. EPA pilot cities as of April 1999. Cities listed in boldface type received grants between 1993 and1996; other cities received grants between 1997 and April 1999.

Birmingham, AL	Wilmington, DE	**Boston, MA**	Wellston, MO	Utica, NY	Brownsville, TX
Prichard, AL	**Clearwater, FL**	Brockton, MA	Columbia, MS	Yonkers, NY	**Dallas, TX**
Uniontown, AL	Fort Myers, FL	Chelsea, MA	Jackson, MS	Campbell, OH	Fort Worth, TX
Phoenix, AZ	Gainesville, FL	**Chicopee, MA**	Missoula, MT	**Cincinnati, OH**	Galveston, TX
Tucson, AZ	Jacksonville, FL	Colrain, MA	Burlington, NC	Cleveland, OH	Grand Prairie, TX
Colton, CA	**Miami, FL**	Everett, MA	**Charlotte, NC**	Columbus, OH	**Houston, TX**
East Palo Alto, CA	St. Petersburg, FL	Greenfield, MA	Fayetteville, NC	Dayton, OH	**Laredo, TX**
Emeryville, CA	Tallahassee, FL	Grt. Barrington, MA	High Point, NC	Girard, OH	**Murray City, UT**
Long Beach, CA	Tampa, FL	Lawrence, MA	Winston-Salem, NC	Hamilton, OH	Ogden City, UT
Los Angeles, CA	**Atlanta, GA**	**Lowell, MA**	Omaha, NE	**Lima, OH**	**Provo, UT**
Montebello, CA	East Point, GA	Lynn, MA	**Concord, NH**	Lockland, OH	**Salt Lake City, UT**
Oakland, CA	Fort Valley, GA	Malden, MA	Nashua, NH	Springfield, OH	**West Jordan, UT**
Pomona, CA	Macon, GA	Mansfield, MA	Atlantic City, NJ	Struthers, OH	**Richmond, VA**
Richmond, CA	Cedar Rapids, IA	Medford, MA	**Camden, NJ**	Toledo, OH	Shenandoah, VA
Sacramento, CA	Clinton, IA	New Bedford, MA	Elizabeth, NJ	Youngstown , OH	**Burlington, VT**
San Diego, CA	Coralville, IA	Pioneer Valley, MA	Jersey City, NJ	Oklahoma City, OK	Aberdeen, WA
San Francisco, CA	Des Moines, IA	**Somerville, MA**	Long Branch, NJ	Tulsa, OK	**Bellingham, WA**
Stockton, CA	Calumet City, IL	Springfield, MA	**Newark, NJ**	**Portland, OR**	Everett, WA
W. Hollywood, CA	Canton, IL	Walpole, MA	Paterson, NJ	Duquesne, PA	Renton, WA
Aurora, CO	Chicago, IL	Westfield, MA	Perth Amboy, NJ	Ford City, PA	**Seattle, WA**
Englewood, CO	East Moline, IL	**Worcester, MA**	**Trenton, NJ**	Johnstown, PA	**Tacoma, WA**
Lakewood, CO	**East St. Louis, IL**	**Baltimore, MD**	Santa Fe, NM	**Philadelphia, PA**	Glendale, WI
North Stapleton, CO	Lacon, IL	Hagerstown, MD	Las Vegas, NV	Phoenixville, PA	Kenosha, WI
Bridgeport, CT	Waukegan, IL	Lewiston, ME	Buffalo, NY	**Pittsburgh, PA**	**Milwaukee, WI**
Danbury, CT	Fort Wayne, IN	**Portland, ME**	Elmira, NY	Reading, PA	Wheeling, WV
Hartford, CT	Indianapolis, IN	**Detroit, MI**	Glen Cove, NY	Charleston, SC	Evanston, WY
Middletown, CT	Wichita, KS	Flint, MI	Johnstown, NY	Columbia, SC	Kemmerer, WY
New Britain, CT	**Kansas City, KS/MO**	**Kalamazoo, MI**	**New York, NY**	Cowpens, SC	
New Haven, CT	**Louisville, KY**	Saginaw, MI	Niagara Falls, NY	**Sioux Falls, SD**	
Norwich, CT	Gretna, LA	Ypsilanti, MI	Ogdensburg, NY	**Knoxville, TN**	
Stamford, CT	**New Orleans, LA**	**Bonne Terre, MO**	**Rochester, NY**	Memphis, TN	
Washington, DC	**Shreveport, LA**	**St. Louis, MO**	**Rome, NY**	Austin, TX	

Table 2. Details on variables.

Variable	Source
Race and ethnicity	
Non-White population	1990 U.S. Census (*29*)
Linguistically isolated households	1990 U.S. Census (*29*)
Hispanic origin population	1994 County and City Data Book (*30*)
Foreign-born population	1994 County and City Data Book (*30*)
Family structure	
Under age 5 population	1990 U.S. Census (*29*)
Age 5–17 population	1990 U.S. Census (*29*)
Age 65 or older population	1990 U.S. Census (*29*)
Female head of households with children	1990 U.S. Census (*29*)
Living in same house in 1985	1990 U.S. Census (*29*)
Living in different house in center city	1990 U.S. Census (*29*)
Living in different house in same MSA	1990 U.S. Census (*29*)
Socioeconomic status	
Population change	1994 County and City Data Book (*30*)
Less than high school education	1990 U.S. Census (*29*)
Bachelor's degree or higher	1990 U.S. Census (*29*)
Unemployment rate	1990 U.S. Census (*29*)
Manufacturing employment	1990 U.S. Census (*29*)

Variable	Source
Socioeconomic status (*continued*)	
Transportation employment	1990 U.S. Census (*29*)
Retail employment	1990 U.S. Census (*29*)
Local government employment	1990 U.S. Census (*29*)
State government employment	1990 U.S. Census (*29*)
Federal government employment	1990 U.S. Census (*29*)
Self-employment	1990 U.S. Census (*29*)
Median household income	1990 U.S. Census (*29*)
Poverty rate	1990 U.S. Census (*29*)
Family poverty rate	1994 County and City Data Book (*30*)
Female head of households poverty rate	1994 County and City Data Book (*30*)
Elderly poverty rate	1994 County and City Data Book (*30*)
Infant death rate	1994 County and City Data Book (*30*)
Serious crime rate	1994 County and City Data Book (*30*)
Housing	
Housing unit change	1994 County and City Data Book (*30*)
Housing vacancy	1990 U.S. Census (*29*)
Owner occupancy	1990 U.S. Census (*29*)
Well-water	1990 U.S. Census (*29*)
Built before 1960	1990 U.S. Census (*29*)

rate; private employment in manufacturing, transportation, and retail; public employment in local, state, and federal governments; and self-employment. We selected two variables to represent the residents' health and safety: infant death rates and the serious crime rates. In addition, we used three other variables for this description: the population change from 1980 to 1992, persons with less than a high school education, and persons with a bachelor's degree or higher. If the U.S. EPA brownfields program is environmentally just, grants should be made to places with high unemployment rates, high infant death rates, high crime rates, and low educational attainment.

We used six variables to describe housing: change in housing units, vacant housing, owner occupancy, housing with a well as the source of drinking water, and housing built before 1960. The change in housing units is an indicator of growth and whether the city is attracting development. Vacant housing is often an indicator of the openness of the housing market, that is, the higher the rate, the lower the rents. It may also indicate housing in poor condition. The age of the housing can be an indicator of the age of the city and of the possible public health threats presented by the use of lead-based paint in older housing. During the 1950s several cities began banning lead paint for interior residential uses, and in 1955 the paint industry voluntarily began to limit the use of lead in interior paint (*33*). Considering these occurrences, we have chosen to use housing built before 1960 as a proxy for the public health threat to children of the housing stock. In acknowledging that some literature suggests using housing built before 1950 as the proxy (*34*), we conducted a Pearson's correlation to measure the association between the two variables of housing built before 1950 and housing built before 1960. The results, which were statistically significant at the 0.01 level ($r = 0.947$), indicate that both variables are highly correlated; thus, we would achieve essentially the same results regardless of whether we used housing built before 1950 or housing built before 1960. In short, to be environmentally just, grants should be made to cities with a disproportionate amount of deteriorating or potentially unsafe housing.

Statistical Findings

Comparison of Pilot Cities with the Nation, States, and Nonpilot Cities

To compare the pilot cities to other places, we conducted five different statistical tests, which are described here along with the results. The variables used in each test were the same. To avoid producing many long tables, we have used several key variables in the first few tables. Before reviewing the results, we need to explain why comparisons were made with states and the nation as a whole. The municipal scale is the critical comparison. However, there are two reasons for the national and state comparisons. One is custom. Beginning with Toxic Wastes and Race in the United States (*18*), many environmental justice studies have provided national, state, and regional perspectives. Second, it was plausible that city versus city comparisons would not show statistically significant differences. If there were no difference between the cities, it would be important to determine if the recipient cities were more needy than their states and the nation as a whole.

Pilot cities compared with nation. In the first test we compared the pilot cities with the United States by using a one-sample *t*-test to compare the mean of the pilot cities for each variable to the actual count for the United States. For each variable this test compares the mean for the observed sample, the pilot cities, against a test statistic, which in this case is the value for the United States, to determine if the observed sample is significantly different from the test statistic. As seen in Table 3, the one-sample *t*-test shows that the pilot cities are very different from the United States as a whole. The pilot cities have significantly higher rates than the United States for non-White population and linguistically isolated households. The pilot cities have significantly higher percentages for persons under 5 and over 65 years of age, female heads of households with children, and persons living in a different house in the center city in 1985. The pilot cities have significantly lower rates for persons 5–17 years of age and persons living in a different house in the same MSA in 1985.

The pilot cities have significantly higher rates for persons with less than a high school education, unemployment, employment in retail trade, transportation, and local government, poverty (persons, families, female heads of households, and elderly), infant death, and serious crime. The pilot cities

Table 3. Comparison of matched brownfields pilot cities to other places.

Variable (%)	Pilot cities (mean)	Comparison cities (mean)[a]	States (mean)[a]	Nation (value)[b]
Race and ethnicity				
Non-White population	0.25	0.16***	0.17***	0.20*
Linguistically isolated households	0.04	0.03	0.03	0.03
Hispanic origin population	0.10	0.09	0.08	0.09***
Foreign-born population	0.08	0.09	0.08	0.08***
Family structure				
Under age 5 population	0.08	0.07	0.07	0.07***
Age 5–17 population	0.18	0.17	0.18*	0.18
Age 65 or older population	0.14	0.14	0.12***	0.13*
Female head of households with children	0.09	0.07***	0.06***	0.06***
Living in same house in 1985	0.53	0.52	0.42***	0.53
Living in different house in center city	0.17	0.14***	0.11***	0.12***
Living in different house in same MSA	0.10	0.11	0.11	0.11
Socioeconomic status				
Population change	0.93	0.14	0.13*	0.12***
Less than high school education	0.28	0.23***	0.24***	0.25**
Bachelor's degree or higher	0.18	0.22**	0.21***	0.20*
Unemployment	0.05	0.04***	0.04***	0.04***
Manufacturing employment	0.17	0.17	0.18	0.18**
Transportation employment[c]	0.04	0.04	0.04	0.04
Retail employment	0.18	0.18	0.17***	0.17***
Local government employment	0.08	0.07**	0.07**	0.07**
State government employment	0.06	0.04*	0.05*	0.05
Federal government employment[c]	0.03	0.04	0.03	0.03
Self employment	0.05	0.06**	0.07***	0.07***
Median household income ($)	26,157	31,246***	31,349***	30,056***
Poverty	0.17	0.12 ***	0.12***	0.13***
Family poverty	0.13	0.10***	0.09***	0.1***
Female head of households poverty	0.34	0.28**	0.34	0.31***
Elderly poverty	0.13	0.12*	0.12*	0.13***
Infant death rate	0.10	0.10	0.09*	0.10***
Serious crime rate	7,728	7,095	5,753***	5,928***
Housing				
Housing unit change	0.13	0.19	0.16	0.16***
Housing vacancy	0.08	0.07	0.10***	0.10***
Owner occupancy	0.54	0.59***	0.64***	0.64***
Well-water	0.01	0.02	0.15***	0.16***
Built before 1960	0.55	0.47***	0.44***	0.41***

***Significant at 99.9%. **Significant at 99.0%. *Significant at 95.0%. [a]Significance tested using matched-pairs test. [b]Significance tested using one-sample *t*-test. [c]Two significant digits does not show the significant difference.

have significantly lower rates for population change, manufacturing employment, self-employment, and median household income. The pilot cities have a higher rate for housing built before 1960. The pilot cities have lower rates for the change in housing units, housing vacancy, owner occupancy, and housing units with well water. The limitation of this initial comparison is that cities are being compared with the entire nation; one may expect these differences because of the unit of comparison, that is, apples are being compared with oranges.

Pilot cities compared with states. For the second test, we compared the pilot cities to their home states by using a paired-samples test of means or proportions. This test compared the means or proportions of sets of variables within the pilot city data set. The data sets were the values of the pilot cities and the values of the states for each variable. This test allowed us to control for regional differences.

The results of the paired-samples test of means or proportions show that the pilot cities are indeed different from their home states. As Table 3 shows, the pilot cities have higher percentages than their home states of non-White population, linguistically isolated households, foreign-born population, and Hispanic-origin population. The pilot cities also have higher percentages of persons under 5 and over 65 years of age, female heads of households with children, persons living in the same house in 1985, and persons living in a different house within the center city in 1985. The pilot cities have lower percentages of their populations in persons 5–17 years of age and persons living in a different house in the same MSA in 1985.

The pilot cities have significantly higher percentages for persons with less than a high school education, unemployment, employment in transportation, local government, and state government, poverty (persons, families, and elderly), infant death, and serious crime. The pilot cities have significantly lower percentages for population change, persons with a bachelor's degree or higher, employment in manufacturing and federal government, and median household income. The pilot cities have a higher rate for housing built before 1960. The pilot cities have lower rates for the change in housing units, housing vacancy, owner occupancy, and housing units with well water.

Overall, the pilot cities are even more different from their states than they are from their matched comparison cities. Nevertheless, states are large political jurisdictions with rural, suburban, and small industrial towns as well as large cities. Thus, the comparison of brownfields grant recipients with their surrounding state is important but hardly definitive.

Pilot cities compared with matched nonpilot cities. For the third test, we also used the paired-samples test of means or proportions, this time to compare the pilot cities with other cities. To see if the U.S. EPA brownfields pilot cities are the same or different from other cities in the United States, we created a second data set of comparison cities. We compiled this data set by trying to match each pilot city to a nonpilot city, using two criteria for a match. First, to control for variation in state policies, both cities had to be in the same state. Second, the population of the comparison city had to be within 30% of the pilot city's population. Although we acknowledge that this could allow for significant population differences in the paired cities, we felt this was not a problem, as sometimes the match is more populous and sometimes less. That is, there is no obvious bias in the data. Although these criteria worked well for many of the cities, there were two problems. First, for some large pilot cities, such as New York and Boston, there were no comparison cities meeting the population criterion. Second, in some states, there were not enough comparison cities available to match with each pilot city. Thus, we have more pilot cities than nonpilot comparison cities. As listed in Table 4, there are 110 comparison cities. We could have used other criteria for selecting matches, including population density and distance. However, the number of matches would have been reduced even further.

We must offer a caveat about the results of our methodology for selecting comparison cities. As previously stated, we did not achieve an even one-for-one match of cities. This was mainly because of two factors. First, for several pilot cities, such as Atlanta, Georgia; Baltimore, Maryland; and New York, the pilot city was the primate city in the state, and thus there were no other cities that met the population criteria of having a population within 30% of the pilot city. Second, for a number of other pilot cities within a single state, such as pilot cities in Connecticut, Massachusetts, and New Jersey, there were several pilot cities of similar size that would all potentially match with the same comparison city. We chose to include the pilot city with the closest population match; therefore, our analysis is based on a subset of pilot cities—those pilot cities that we successfully matched. One may question if this produces bias in our further statistical analysis and results. It did not.

For each variable we compared the mean of the matched pilot cities to the mean of the nonmatched pilot cities. There are statistically significant differences for only five variables, of which three proved to be important in further statistical analyses as reported below. For all three of these variables, the percent of the population that is non-White; the percent of the population with a bachelor's degree or higher, and the percent of households that are owner occupied, the pretest showed that our results most likely underestimate the differences between pilot cities and nonpilot comparison cities. Thus, our results make the pilot cities look less distressed than they may actually be.

Table 4. Cities used for the matched comparison to U.S. EPA pilot cities.

Bessemer, AL	Glenview, IL	Butte-Silver, MT	New Castle, PA
San Clemente, CA	Bourbonnais, IL	Goldsboro, NC	Scranton, PA
Seal Beach, CA	Bellwood, IL	Asheville, NC	N. Charleston, SC
Livermore, CA	Tinley Park, IL	Durham, NC	Chattanooga, TN
Oceanside, CA	Schaumburg, IL	Rochester, NH	Nashville–Davidson, TN
El Cajon, CA	Evansville, IN	Manchester, NH	El Paso, TX
Fresno, CA	Topeka, KS	West New York, NJ	Abilene, TX
San Jose, CA	Lexington–Fayetteville, KY	Clifton, NJ	San Antonio, TX
Riverside, CA	Natchitoches, LA	Westfield, NJ	Port Arthur, TX
Danville, CA	Baton Rouge, LA	New Brunswick, NJ	Waco, TX
Colorado Springs, CO	Fall River, MA	Las Cruces, NM	Plano, TX
Wheat Ridge, CO	Melrose, MA	North Tonawanda, NY	St. George, UT
Pueblo, CO	Woburn, MA	Middletown, NY	Orem, UT
Bristol, CT	Hyannis, MA	Port Jervis, NY	West Valley City, UT
Milford, CT	Newton, MA	Schenectady, NY	Layton, UT
Norwalk, CT	Haverhill, MA	Endictott, NY	Newport News, VA
Shelton, CT	Waltham, MA	Hempstead, NY	Oak Harbor, WA
Waterbury, CT	Barnstable, MA	Mt Vernon, NY	Yakima, WA
Miami Beach, FL	Cambridge, MA	Syracuse, NY	Bellevue, WA
Tamarac, FL	Hingham, MA	Akron, OH	Bremerton, WA
Coral Springs, FL	Leominster, MA	Dover, OH	Spokane, WA
Hollywood, FL	Bowie, MD	Kettering, OH	Shorewood, WI
Smyrna, GA	Bangor, ME	Newark, OH	Racine, WI
St. Mary's, GA	Warren, MI	Granville, OH	Parkersburg, WV
Savannah, GA	Southfield, MI	Lorain, OH	New Castle, WV
Davenport, IA	Taylor, MI	Salem, OH	Rawlins, WY
Mason City, IA	Warrentown, MO	Parma, OH	
Oskaloosa, IA	Aberdeen, MS	Hokendauqua, PA	

The results of the paired-samples test of means or proportions show that the pilot cities differ from their comparison cities. Most notably, as Table 3 shows, the pilot cities have more non-Whites and higher unemployment and poverty rates. In addition, the test shows that for some indicators, the pilot cities show no difference, including differences for changes in population and housing units. Because brownfields are thought to discourage urban growth, we would have expected the pilot cities to have lower rates of change on variables that signify growth and attractiveness.

The pilot cities have significantly ($p < 0.05$) higher means than their comparison cities for the following indicators: non-White population, female heads of households with children, persons living in a different house in the same center city in 1985, persons with less than a high school education; unemployment; local and state government employment; poverty (persons, families, female heads of households, and elderly); and housing units built before 1960. The pilot cities have significantly smaller proportions of their population having a bachelor's degree or higher and being self-employed. They also have lower median household incomes and lower rates of owner-occupied housing.

Initial pilot cities compared with newer pilot cities. For the fourth test we compared cities initially receiving pilot status (1993–1996) and those cities receiving pilot status later (1997–1999), using an independent sample *t*-test to compare the means of each group. This test compares the means of each group to determine if the two groups differ significantly from one another. We used this test independently for each variable in the data set. As shown in Table 5, the independent sample *t*-test shows that the initial set of pilot cities (cities receiving grants in the first 3 years of the program) are different from those cities receiving pilot status more recently. The older pilots have significantly higher percentages of non-White population, persons living in a different house in the same center city in 1985, transportation employment, and poverty (persons, family, elderly). The older pilot cities also have significantly lower percentages for manufacturing employment and owner-occupied housing.

Overall, people in the older pilot cities are more likely to be non-White, slightly poorer, and not residing in homes they own.

Table 5. Comparison of initial pilot cities (1993–1996) to newer pilot cities (1997–1999).

Variable	Mean for initial pilot cities ($n = 59$)	Mean for newer pilot cities ($n = 126$)
Non-White	0.35	0.26*
Different house in center city	0.24	0.19***
Manufacturing	0.15	0.18**
Transportation	0.05	0.04*
Poverty, persons	0.19	0.16*
Poverty, family	0.16	0.13*
Poverty, elderly	0.15	0.13*
Owner occupancy	0.49	0.53*

***Significant at 99.9%. **Significant at 99.0%. *Significant at 95.0%.

All Pilot Cities Compared with All Comparison Cities

Our final set of tests was to compare all of the pilot cities to all of the nonpilot cities. We again used an independent sample *t*-test. The independent sample *t*-test shows that the pilot cities have significantly higher rates than the nonpilot cities for non-White population and linguistically isolated households. The pilot cities have significantly higher rates for female heads of households with children and persons living in a different house in the same center city in 1985. The pilot cities have a significantly lower rate for persons living in a different house in the same MSA in 1985.

As Table 6 shows, the pilot cities have significantly higher rates for persons with less than a high school education, unemployment, employment in local government, poverty (persons, families, elderly, female heads of households), infant death, and serious crimes. Pilot cities have significantly lower rates for population change, person with a bachelor's degree or higher, self-employment, and median household income.

The pilot cities have a significantly higher rate for housing built before both 1960. The pilot cities have significantly lower rates for the growth in housing units and owner occupancy.

Overall, the pilot cities tend to have more people than other cities who are less educated, victims of serious crimes, slightly poorer, suffer from higher infant mortality rates, and reside in older housing and homes they do not own.

Discussion

Has the U.S. EPA brownfields redevelopment program functioned as an environmental justice program? Has it targeted the most

Table 6. Comparison of all U.S. EPA brownfields pilot cities to other places.

Variable (%)	Pilot cities (mean)	Comparison cities (mean)[a]
Race and ethnicity		
Non-White population	0.29	0.16***
Linguistically isolated households	0.04	0.03*
Hispanic origin population	0.10	0.11
Foreign-born population	0.09	0.10
Family structure		
Under age 5 population	0.08	0.07
Age 5–17 population	0.17	0.17
Age 65 and older population	0.14	0.14
Female heads of households with children	0.09	0.07***
Living in same house in 1985	0.53	0.53
Living in different house in center city	0.20	0.13***
Living in different house in same MSA	0.09	0.12**
Socioeconomic status		
Population change	0.07	0.13*
Less than high school education	0.28	0.23***
Bachelor's degree or higher	0.19	0.22*
Unemployment	0.05	0.04***
Manufacturing employment	0.17	0.18
Transportation employment[b]	0.04	0.04
Retail employment	0.18	0.18
Local government employment	0.08	0.07*
State government employment[a]	0.05	0.04
Federal government employment[a]	0.03	0.04
Self employment	0.05	0.06***
Median household income ($)	25,840	31,336***
Poverty	0.17	0.12***
Family poverty	0.14	0.10***
Female head of households poverty	0.35	0.28***
Elderly poverty	0.14	0.12**
Infant death rate	0.11	0.10**
Serious crime rate	9,380	7,583**
Housing		
Housing unit change	0.11	0.17*
Housing vacancy	0.09	0.08
Owner occupancy	0.51	0.60***
Well-water	0.01	0.02
Built before 1960	0.56	0.47***

***Significant at 99.9%. **Significant at 99.0%. *Significant at 95.0%. [a]Significance tested using independent *t*-test. [b]Two significant digits do not show the significant difference.

Table 7. Matched pair: description of pilot cities. The pilot cities have significantly higher means than their comparison cities for the variables listed.

Variable	Pilot mean (%)	Difference in means (%)	Lowest rate (%)	Lowest rate Location	Highest rate (%)	Highest rate Location
Non-White population	25	+9	0	Bonne Terre, MO	99	East St. Louis, IL
Female head of households with children	9	+2	2	West Hollywood, CA	25	Camden, NJ
Persons living in a different house in the center city in 1985	17	+4	0	Several cities	36	Several cities
Persons with less than a high school education	28	+5.5	9	Coralville, IA	55	Brownsville, TX
Unemployment	5	+1.2	2	Several cities	16	Wellston, MO
Local government employment	7.5	+0.6	3	West Hollywood, CA	13	East St. Louis, MO; Rome, NY
State government employment	6	+1.5	1	Several cities	31	Coralville, IA; Tallahassee, FL
Poverty, persons	17	+5	4	Several cities	47	Wellston, MO
Poverty, families	13	+3.3	3	Bellingham, WA	47	Prichard, AL
Poverty, female head of households	34	+6	11	Medford, MA	67	Prichard, AL
Poverty, persons over age 65 years	13	+1.5	45	Dallas, TX	45	Bellingham, WA; Provo, UT
Housing units built before 1960	55	+7	4	West Jordan, UT	87	Elmira, NY
Persons with a bachelor's degree or higher degree	18	–4	2	Wellston, MO	44	Coralville, FL
Self-employed persons	5	–0.8	2	Bonne Terre, MO; East St. Louis, IL	13	Santa Fe, NM; West Hollywood, CA
Median household income ($)	26,157	–5,089 (–16.3%)	11,567	Pricard, AL	49,787	Stamford, CT
Owner occupancy	54%	–5.3%	22%	West Hollywood, CA	79%	West Jordan, UT

economically distressed cities in the United States? As this study has shown, the U.S. EPA brownfields pilot cities differ from other cities, including those of a similar population size in the same state, their home states, and the nation as a whole. As Table 7 shows, these pilot cities are more distressed. Their unemployment rate is higher, median household income is lower, and poverty rates are higher. Their residents are less educated. Home ownership is lower and the housing stock is older.

Future Research and Policy Suggestions

Having established that the neediest communities on the whole were provided with funds before the less needy ones, the next step in understanding the relationship between brownfields redevelopment and environmental justice will be to look at political, economic, and social characteristics of the neighborhoods in which brownfields are located. We want to collect statistics that allow us to measure meaningful policy impacts on neighborhoods. This includes census data analysis at the tract or block level. Such analysis would allow us to determine if the money is actually having environmentally just benefits by going to the most distressed neighborhoods. Additionally, when Census 2000 data are available, we want to expand our study to see changes since the brownfields program started. This would allow us to measure inequality over time among neighborhoods in the cities. We could learn if the neighborhoods in cities that were the most distressed in 1990 are still disproportionately distressed, or if they have seen improvements that could come from brownfields redevelopment.

We would also like to see future research on how planners, public health advocates, and others professionally involved with brownfields redevelopment could bring about environmental justice. With this in mind, we have a developed a broadly defined recommended policy research agenda.

To manage impacts from the significantly low or declining population, we want to consider if the redevelopment focus should forgo neighborhoods for downtowns. Which works better for poor people living in distressed neighborhoods—the single $100 million shopping mall, or five investments in different neighborhoods of $20 million each? The socioeconomic variables show that these brownfields pilot cities have many unemployed and poor people with low educational skills. If redevelopment is aimed at trying to bring in living-wage jobs appropriate to the skills of current residents, will it have a just effect? Who is getting the jobs at those sites? In addition, we want to know the effects of having worker-training programs to teach new skills for new jobs. In terms of education, school improvements could be tied to redevelopment. To address the public health needs of the community, for instance, to reduce the infant death rates, we think the development of public education outreach programs and the creation of neighborhood health clinics should be explored as part of large-scale brownfields redevelopment programs. Finally, we would like to know if brownfields redevelopment can be directly tied to increasing safety and reducing crime by reducing neighborhood blight, cleaning streets, and improving street lights as part of a neighborhood-oriented program.

Building housing on former brownfields sites is an open issue, because of the fears of the buyers and sellers. Nonetheless, to increase owner occupancy, redevelopment of brownfields can include the development of programs to encourage home ownership, such as offering low-rate loans to low-income persons or persons with no or poor credit. Most important, resident preferences for land use on redeveloped sites should be sought. All these preferences are not likely to be satisfied, but it is important that local officials and developers meet with resident leaders to determine what accommodations are feasible within the overall design and budget of the project. Overall, this analysis shows that the U.S. EPA brownfields pilot program has distributed funds in a way that is consistent with an effort to address environmental justice issues and the larger set of social justice issues within which these are embedded.

Appendix

Cities with Incomplete Data

The cities listed below, with population under 25,000, are without data for the following variables: Hispanic origin, foreign born population, change in population, infant death rate, serious crime rate, poverty for families, female heads of households, persons over 65 years of age, and change in housing units.

Pilot cities. Uniontown, Alabama; East Palo Alto, California; Emeryville, California; Fort Valley, Georgia; Canton, Illinois; East Moline, Illinois; Lacon, Illinois; Coralville, Iowa; Gretna, Louisiana; Great Barrington, Massachusetts; Greenfield, Massachusetts; Mansfield Center, Massachusetts; Walpole, Massachusetts; Ypsilanti, Michigan; Bonne Terre, Missouri; Wellston, Missouri; Columbia, Mississippi; Glen Cove, New York; Johnstown, New York; Ogdensburg, New York; Campbell, Ohio; Girard, Ohio; Lockland Village, Ohio; Duquesne, Pennsylvania; Ford City, Pennsylvania; Phoenixville, Pennsylvania; Evanston, Wyoming; Kemmerer, Wyoming.

Comparison cities. Erie, Colorado; St Mary's, Georgia; Bellwood, Illinois;

Bourbonnais, Illinois; Evansville, Illinois; Oskaloosa, Iowa; Natchitoches, Louisiana; Barnstable Villa, Massachusetts; Hingham, Massachusetts; Hyannis, Massachusetts; El Dorado Spring, Missouri; Warrenton, Missouri; Aberdeen, Mississippi; Endicott, New York; Middletown, New York; Port Jervis, New York; Dover, Ohio; Granville Village, Ohio; Salem, Ohio; Hokendauqua, Pennsylvania; Shorewood, Wisconsin; Newcastle, Wyoming; Rawlins, Wyoming.

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